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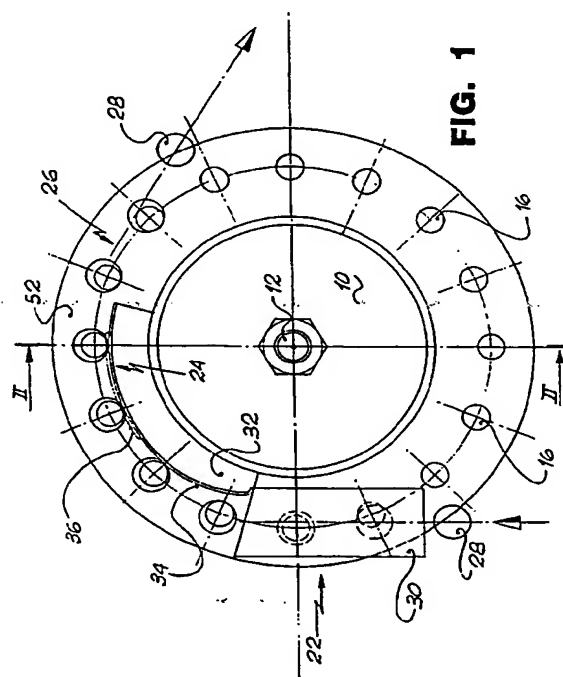
54 **Machine and method for making weakening cuts, particularly on container caps.**

57 There is described a machine for making weakening cuts, particularly on caps (28) provided with a side skirt (60) and a top disc (62), said side skirt (60) ending at the bottom in a ring (66) which has a reduced thickness, is provided with a fastening flap (58) and is intended to form a tamper-proof band after the weakening cuts have been made, said machine being characterised in that it comprises in combination :

a support surface (40) intended for the ring (66) and provided with cutting teeth (42) generally at right angles to said surface, which are aligned and separated from one another by gaps (44) ;

and a device which holds said ring (66) of said cap (28) in forced contact with said support surface and at the same time brings about a reciprocal rolling movement, without slipping, of the cap (28), relative to the surface (40), in the direction of alignment of said cutting teeth (42),

the arrangement being such that the breakable bridges which remain in place on said ring (66), in positions corresponding to the gaps (44), are located along a circumference lying in a plane at right angles to the axis of the cap (28).



EP 0 533 633 A2

The present invention relates to a machine intended for mechanically and automatically making highly accurate weakening cuts, particularly on plastics caps for containers such as bottles or the like. Weakening cuts of this kind serve for example for delimiting the zone constituting a tamper-proof band which is intended to be separated from the cap when the package is opened.

In the Applicant's Italian Patent 1,211,905 a composite tamper-proof closure cap is described, which has a moulded plastics side skirt part provided with a screw thread or other means for fastening the cap to the container. At the bottom of the side skirt a peripheral ring of reduced thickness is provided, in which is formed a tamper-proof band serving to make immediately visible any tampering with the package to which the cap has been applied, before the actual authorised opening of said package.

The tamper-proof band is fixed to the plastics side skirt by means of breakable bridges and is provided with a continuous flap turned over towards the interior of the cap and intended to engage a projection formed on the neck of the container, so that, when the cap is unscrewed, the breakable bridges are torn away and the tamper-proof band is separated from the side skirt of the cap.

This provides clear proof that an attempt has been made to open the package even before the top metal disc completing the cap has been actually separated from the mouth of the container.

A first method used hitherto for forming the weakening zone between the side skirt and the tamper-proof band consists in forming, during the process of moulding the cap, numerous bridges fastened to and connecting together the two parts of the cap. These bridges are separated from one another by generally rectangular gaps and are equally spaced over the circumference of the side skirt.

A second method consists in forming, during the process of moulding the cap, numerous protuberances on the inside wall of the side skirt so as to produce an increased wall thickness, since said protuberances extend radially towards the interior of the remaining part of the side skirt. In a subsequent operation a continuous circumferential cut of constant depth is then made in the cross-section of the skirt, cutting through the side skirt but leaving intact the protuberances previously formed. The intact protuberances thus form bridges between the side skirt in the upper part and the tamper-proof band in the lower part, said band thus being formed by circumferentially cutting through the ring of reduced thickness of the side skirt.

However, both these methods have the disadvantage of great inaccuracy in the formation of the bridges, thus making it difficult subsequently to open the package.

In the first method the inaccuracy is inherent to

the method of moulding the plastics material, which does not make it possible to form equally spaced bridges of equal thickness in a simple and economical manner.

In the second method the operation of making the circumferential cut can be carried out with greater precision in an adequately economical manner; nevertheless, the inaccuracy and tolerances in the thickness of the parts moulded at high speed do not permit high precision in the formation of the bridges, in view of the fact that the protuberances are sometimes too thin to produce sufficiently strong bridges or are simply cut right through. On the other hand, the thickness of the side skirt is sometimes too great and the cut is therefore not sufficiently deep to form separate bridges.

The main object of the present invention is therefore that of providing an improved cap which between the side skirt and the tamper-proof band has a weakening zone which is made with great accuracy both in respect of the distance between the bridges and in respect of their thickness.

Another object of the present invention is that of producing a cap of this kind with the aid of a simple and economical machine which utilises a method of making highly accurate weakening cuts.

According to the present invention a machine for making weakening cuts on caps of the kind indicated is characterised by the fact that it comprises in combination:

a support surface intended for the ring and provided with cutting teeth generally at right angles to said surface, which are aligned and separated from one another by gaps, and

a device which holds the cap ring in forced contact with the support surface and at the same time brings about a reciprocal rolling movement, without slipping, of the cap, relative to the surface, in the direction of alignment of the cutting teeth,

the arrangement being such that the breakable bridges which remain in place on the ring, in positions corresponding to the gaps, are located along a circumference lying in a plane at right angles to the axis of the cap.

According to another aspect of the present invention, a method of making weakening cuts on caps of the kind indicated comprises the operations of: providing for the ring a support surface equipped with cutting teeth generally at right angles to said surface, which are aligned and separated by gaps; and causing the side skirt of a cap to roll, in a reciprocal relative movement without slipping, in forced contact with the support surface, in such a manner that the cutting teeth penetrate into said side skirt along a circumference lying in a plane at right angles to the axis of the cap, the arrangement being such that, at the end of one complete rotation about the side skirt of the cap, in positions corresponding to the gaps between the

cutting teeth, numerous bridges remain in place on the side skirt of the cap, their number being equal to the number of the gaps, said bridges separably connecting the side skirt to the tamper-proof band.

The principal advantage obtained with the machine according to the present invention therefore consists in the considerable accuracy in the making of the cuts, both as regards their height and as regards their length, even when there are substantial differences in the thickness of the ring of the side skirt of the cap, because of the complete absence of relative slipping between the cutting elements and the cap.

Another advantage consists in the constancy and repeatability of the cuts in the presence of variable thicknesses of the plastics material along the entire circumference of the cap.

Yet another advantage consists in the fact that along the weakening line formed by the present machine there are no missing bridges and no zones where cuts have not been made.

The present invention will be further explained below and other advantages will emerge from the description of a practical embodiment of the machine for making weakening cuts on container caps, this description being given solely by way of example and without limitation, with reference to the accompanying drawings, in which:

Figure 1 is a schematic plan view of the present machine;

Figure 2 is a partial view in section, with parts omitted, taken on the line II-II in Figure 1;

Figure 3 is a partial view in section, with parts omitted, taken on the line III-III in Figure 2; and

Figure 4 is a partial view in section, with parts omitted, taken on the line IV-IV in Figure 3.

Referring to the figures of the accompanying drawings, and in particular to Figures 1 and 2 thereof, it can be seen that the present machine for making weakening cuts on container caps comprises a main plate 10, fastened to the main frame of the machine, and immovable relative to said main frame.

A main shaft 12 is also fastened to the machine frame and to the main plate 10, and a planet wheel carrier disc 14 (see Figure 2), driven by a mechanical drive device (not shown), rotates about said shaft.

The planet wheel carrier disc 14 supports rotatably numerous planet wheels 16, which are sixteen in number in the embodiment illustrated in the drawings, although this number can be increased or reduced in accordance with requirements dictated by the size of the machine.

The perimetral edge of the main plate 10 is given gear teeth at 18 (see Figure 2), and each planet wheel 16 carries gear teeth 20 meshing with the gear teeth 18 on the main plate 10. In this way the planet wheels 16 are turned about their axis when the planet wheel carrier disc 14 turns about the main shaft 12.

As is more clearly shown in Figure 1, the present machine also includes a cap admission station 22, a cutting station 24, and a station 26 for the discharge of said caps.

The caps 28 are continuously fed to the admission station 22 by means of a chute 30, at the end of which they wait to be picked up by the head of the planet wheels 16 during the rotation, in the clockwise direction with reference to Figure 1, of the planet wheel carrier disc 14 and thus to be carried through the cutting station 24 where, as will be more fully described further on, the profiled cut forming the tamper-proof band is made.

After passing through the cutting station 24, the caps 28 leave the machine at the discharge station 26, where they are taken off by electromagnetic devices, if they have metallic parts, or by suction devices if they are made of plastics material, or by any other of the many devices which are known to those skilled in the art and are suitable for the purpose.

The cutting station 24 has a blade carrier device 32 provided, at the inlet zone of the cutting station 24, with an inclined approach surface 34 and, in the central zone of the cutting station 24, with a blade 36 intended for making the actual cut, as will be more fully described further on.

Reference will now be made to Figures 3 and 4, in which the cutting station 24 is shown together with a cap 28 on which a cut is being made in order to define the tamper-proof band in relation to the side skirt of said cap.

The blade carrier device 32 is of sandwich construction and receives in its interior the actual blade 36, together with electrical resistors 38 for heating said blade in order to obtain a better cut.

On its side facing the cap 28 (see Figure 4) the blade 36 is so shaped as to have a top surface 40 having a cylindrical conformation intended to form a support for the cap ring during the cutting operation, while at the bottom said blade is provided with numerous cutting teeth 42 in alignment with one another along the blade 36. As can be better seen in Figure 3, the cutting teeth 42 are separated from one another by gaps 44.

As can be more clearly seen in Figure 4, each planet wheel 16 has a baseplate 46, on which the cap 28 is supported during the cutting operation, and also a cylindrical body 48 which holds the cap 28 against the blade 36 during the cutting operation. Above the cylindrical body 48 each planet wheel 16 ends in a frustoconical head 50 intended to facilitate the picking-up of the cap 28 in the admission station 22 and its positioning on the planet wheel 16.

A hood 52 fastened to the main plate 10 contributes towards the vertical positioning of the caps 28.

The cylindrical body 48 of the planet wheel 16 is provided with vertical channels forming a rack and has a groove 54 in line with the cutting teeth 42 and

a groove 56 in which a fastening flap 58 of the tamper-proof band of the cap 28 is received during the cutting operation, in order to avoid damage to it.

The cap 28, which is shown in Figure 4 in the position which it occupies while the cut is being made, comprises itself in known manner a side skirt 60, which in its interior is provided with screw threads or other engaging means intended to match similar engaging means formed on the neck of the container.

The cap 28 also comprises a disc-like top part 62, generally made of metal but sometimes also of plastics material, which is intended to close the mouth of the container in conjunction with a sealing ring 64.

The bottom part of the side skirt 60 of the cap 28 ends in a ring 66 of reduced thickness, which is provided with the previously mentioned fastening flap 58 and is intended to form the tamper-proof band after the operation of making the weakening cut with the aid of the present machine.

It should then be noted that the surface 40, forming part of a cylinder, of the blade 36 corresponds to the same ideal cylinder to which the generatrix of the toothing 18 of the main plate 10 corresponds, as can more clearly be seen in Figure 2.

During operation, the planet wheel carrier disc 14 is rotated in the clockwise direction, referring to Figure 1, about the main shaft 12, and each planet wheel 16 turns about its own axis in the clockwise direction, referring to Figure 1, because of the coupling of the gear teeth 20 thereof to the gear teeth 18 attached to the main plate 10.

When each planet wheel 16 arrives at the admission station 22, the latter picks up and carries with it the first cap 28 waiting on the chute 30.

In the following movement, the cap 28 is positioned by the action of centrifugal force and by the action of the approach surface 34, so as to remain held by an interference fit between the cylindrical support surface 40 of the blade 36 and the channelled surface of the cylindrical body 48 of the planet wheel 16.

Since, as already stated, the generatrix of the gear teeth 18 corresponds to the cylinder to which the cylindrical support surface 40 corresponds, and since the presence of the rack-like channels on the cylindrical body 48 and their interference fit with the plastic material of the cap 28 prevent slipping between the cap 28 and the cylindrical body 48 of the planet wheel 16, the effect is that the cap 28 is made to roll on the cylindrical support surface 40 without any possibility of slipping.

As the side skirt 60 of the cap 28, which, as has been seen, rolls without slip on the cylindrical support surface 40, encounters each cutting tooth 42, the latter makes a cut in the ring 66 of reduced thickness, as best seen in Figure 4, while in positions facing the gaps 44 a connecting bridge between the side skirt and the tamper-proof band is left intact in the ring 66.

The presence of the electrical resistors 38, the

supply of current to which is controlled by an appropriate temperature-sensitive regulation device (not shown), enables the temperature of the blade 36 to be raised so as to achieve perfect separation of the plastics material in the zone affected by the cutting.

After the cap 28 has made a complete revolution about its own axis, rolling without slipping on the cylindrical support surface 40 of the blade 36, the cap encounters on the blade 36 a zone devoid of cutting teeth and at the end the planet wheel 16 reaches the discharge station 26, where the cap 28 is taken off from the present machine, as already stated, to be passed on for further processing.

From the foregoing it is therefore obvious that with the present machine a method is carried out which consists essentially of the operations of: providing for the cap ring 66 a support surface 40 equipped with cutting teeth 42 generally at right angles to said surface, which are aligned and separated by gaps 44; and causing the side skirt 60 of a cap 28 to roll, in a reciprocal relative movement without slipping, in forced contact with the support surface 40, in such a manner that the cutting teeth 42 penetrate into said side skirt along a circumference lying in a plane at right angles to the axis of the cap, the arrangement being such that, at the end of one complete rotation about the side skirt of the cap, in positions corresponding to the gaps 44 between the cutting teeth 42, numerous bridges remain in place on the side skirt 60 of the cap 28, their number being equal to the number of the gaps 44, said bridges separably connecting the side skirt to the tamper-proof band.

Since caps of various diameters are produced, it is desirable that the present machine should be easily adaptable to operate with caps of different diameters. For this purpose, with the present machine it is only necessary to change the blade 36 as a whole, replacing it with a new blade having a number of cutting teeth 42 and gaps 44 appropriate for the new diameter of the cap with which it is desired to operate. It is in fact obvious that the length of the portion provided with teeth 42 on the blade 36 must always correspond to the outside circumference of the cap on which the cut is to be made, in order to avoid superimposed cuts.

Analogously, the number of gaps 44 must correspond to the desired number of bridges, and this in turn will depend on the diameter of the cap being processed.

It will therefore be noted how the major part of the present machine, such as the main plate, the planet wheel carrier disc, the planet wheels and their connection means, can be used for working with caps of any diameter, since they hold the cap only in the zone in which the cut is being made, irrespective of the diameter of said cap.

It is now obvious that the support surface 40 for the ring 66 need not necessarily correspond to a cy-

linder; it may have any shape, even a plane shape, because its only purpose is to provide support for the cap ring 66 during the cutting operation.

It is in addition possible to provide a device which will hold the cap 28 fast and will move the blade 36 around its side surface. This substantially corresponds to reversing the functions of the blade 36 and planet wheel 16 in relation to the cap 28 being processed, by holding the wheel still and moving the blade, obviously without this implying any modification of the principles on which the present invention is based.

Although for the sake of convenience the cylindrical body 48 of the planet wheel 16 has been stated to be channelled in order to obtain an interference fit between said planet wheel 16 and the blade 36, it is entirely obvious that the rack-like channelling can be formed on the blade 36 or on both these members.

Furthermore, the rack-like channelling may be replaced by any similar expedient producing corrugations on the surface of the various members in order to assist engagement and prevent the slipping of the cap, while it is also obvious that an expedient of this kind can be dispensed with if the friction between the plastics material, or other material of which the cap is made, and the materials of which the blade 36 and the cylindrical body 48 of the planet wheel 16 are made is sufficient to prevent slipping between the surfaces coupled together by force.

Moreover, although reference has been made throughout to container caps as the objects processed by the machine of the present invention, it is clear that the same inventive principles and the same machine can be used for making weakening cuts on any objects made of any materials.

Although only a preferred embodiment of the machine for making weakening cuts has been specifically illustrated and described herein, it is to be understood that minor variations may be made in the machine construction without departing from the spirit and scope of the invention as defined by the appended claims.

Claims

1. Machine for making weakening cuts, particularly on caps (28) provided with a side skirt (60) and a top disc (62), said side skirt (60) ending at the bottom in a ring (66) which has a reduced thickness, is provided with a fastening flap (58) and is intended to form a tamper-proof band after the weakening cuts have been made, said machine being characterised by the fact that it comprises in combination:

a support surface (40) intended for the ring (66) and provided with cutting teeth (42) generally at right angles to said surface, which are

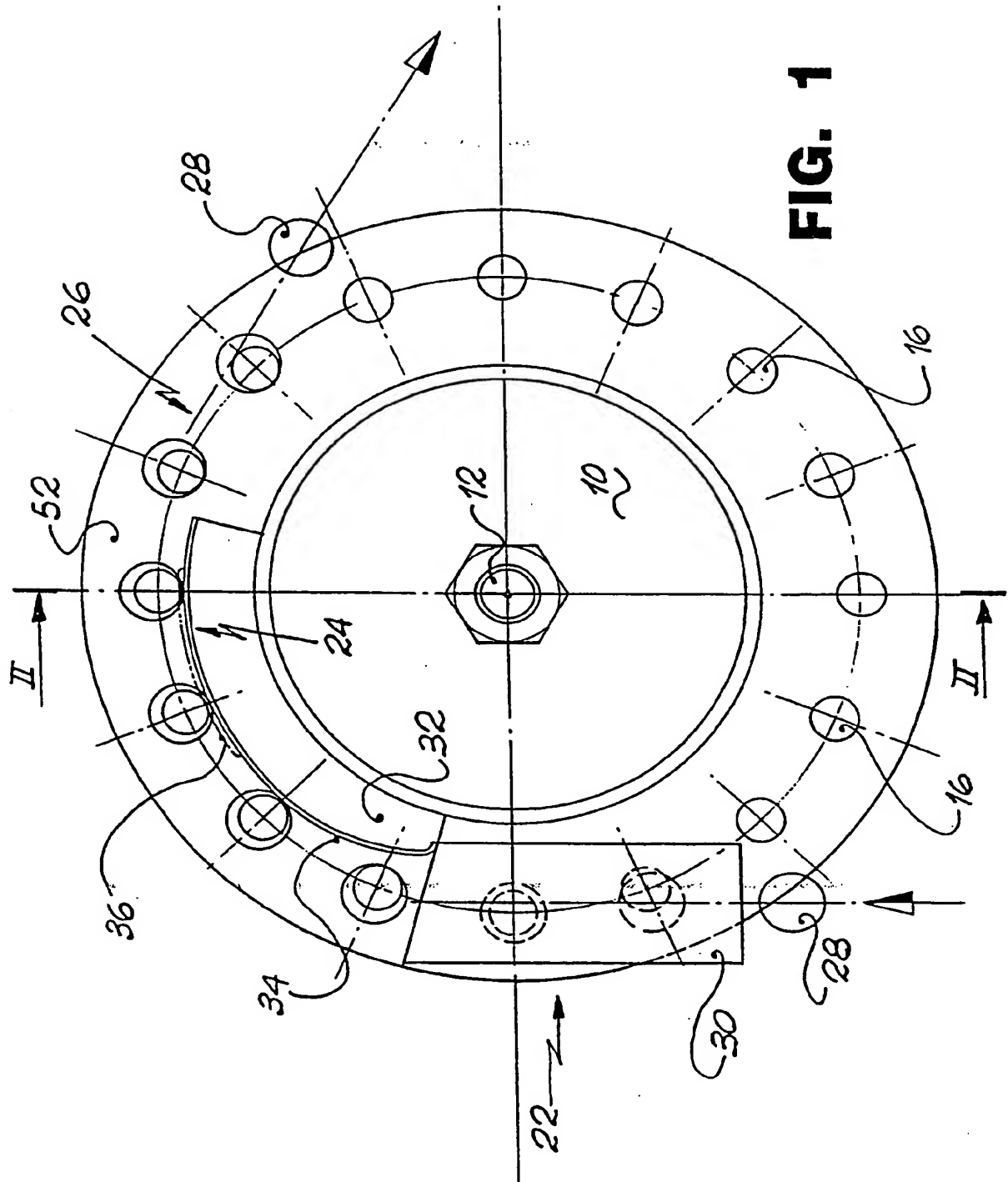
aligned and separated from one another by gaps (44), and

a device which holds said ring (66) of said cap (28) in forced contact with said support surface and at the same time brings about a reciprocal rolling movement, without slipping, of the cap (28), relative to the surface (40), in the direction of alignment of said cutting teeth (42),

the arrangement being such that the breakable bridges which remain in place on said ring (66), in positions corresponding to the gaps (44), are located along a circumference lying in a plane at right angles to the axis of the cap (28).

2. Machine according to Claim 1, characterised by the fact that said support surface (40) is provided with parts forming on said surface corrugations adapted to convert the forced contact between the cap (28) and the support surface (40) into engagement by an interference fit.
3. Machine according to Claim 2, characterised by the fact that said corrugating parts consist of rack-like channelling.
4. Machine according to any of the preceding claims, characterised by the fact that said support surface (40) is a surface forming part of a cylinder and said cutting teeth are positioned along a circumference belonging to a plane at right angles to the axis of the cylinder.
5. Machine according to any of the preceding claims, characterised by the fact that said device holding said ring (66) of said cap (28) in forced contact with said support surface (40) is provided with parts forming corrugations on its outer surface and adapted to convert the forced contact between it and the cap (28) into engagement by an interference fit.
6. Machine according to Claim 5, characterised by the fact that said corrugating parts consist of rack-like channelling.
7. Machine according to any of the preceding claims, characterised by the fact that said device holding said ring (66) of said cap (28) in forced contact with said support surface (40) consists of a rotatable cylindrical body (48).
8. Machine according to Claim 4, characterised by the fact that said device holding said ring (66) of said cap (28) in forced contact with said support surface (40) consists of a cylindrical body (48) rotating about said support surface (40) and at the same time rotating about its own axis.

9. Machine according to Claim 8, characterised by the fact that said support surface (40) is fastened to a main plate (10) and said cylindrical body (48) is mounted for rotation on a planet wheel carrier disc (14) rotating coaxially with said main plate (10). 5
10. Machine according to Claim 9, characterised by the fact that main gear teeth (18) are provided coaxially with said support surface and attached to said main plate (10), and said cylindrical body (48) is attached to secondary gear teeth (20) meshing with said main gear teeth (18). 10
11. Machine according to Claim 10, characterised by the fact that the radius of the generatrix of said main gear teeth (18) is equal to the radius of the cylinder to which the support surface (40) corresponds. 15
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12. Machine according to any of Claims 7 to 11, characterised in that numerous cylindrical bodies (48) are provided, which in succession engage said support surface (40). 25
13. Method of making weakening cuts, particularly on caps (28) provided with a side skirt (60) and a top disc (62) and in which the side skirt (60) ends at the bottom in a ring (66) of reduced thickness provided with a fastening flap (58) and intended to form a tamper-proof band after the weakening cuts have been made, said method being characterised by the fact that it comprises the operations of: 30
- providing for the ring (66) a support surface (40) equipped with cutting teeth (42) generally at right angles to said surface, which are aligned and separated by gaps (44); and 35
- causing the side skirt (60) of a cap (28) to roll, in a reciprocal relative movement without slipping, in forced contact with the support surface (40), in such a manner that the cutting teeth (42) penetrate into said side skirt along a circumference lying in a plane at right angles to the axis of the cap, 40
45
- the arrangement being such that, at the end of one complete rotation about the side skirt of the cap, in positions corresponding to the gaps (44) between the cutting teeth (42), numerous bridges remain in place on the side skirt (60) of the cap (28), their number being equal to the number of the gaps (44), said bridges separably connecting the side skirt to the tamper-proof band. 50
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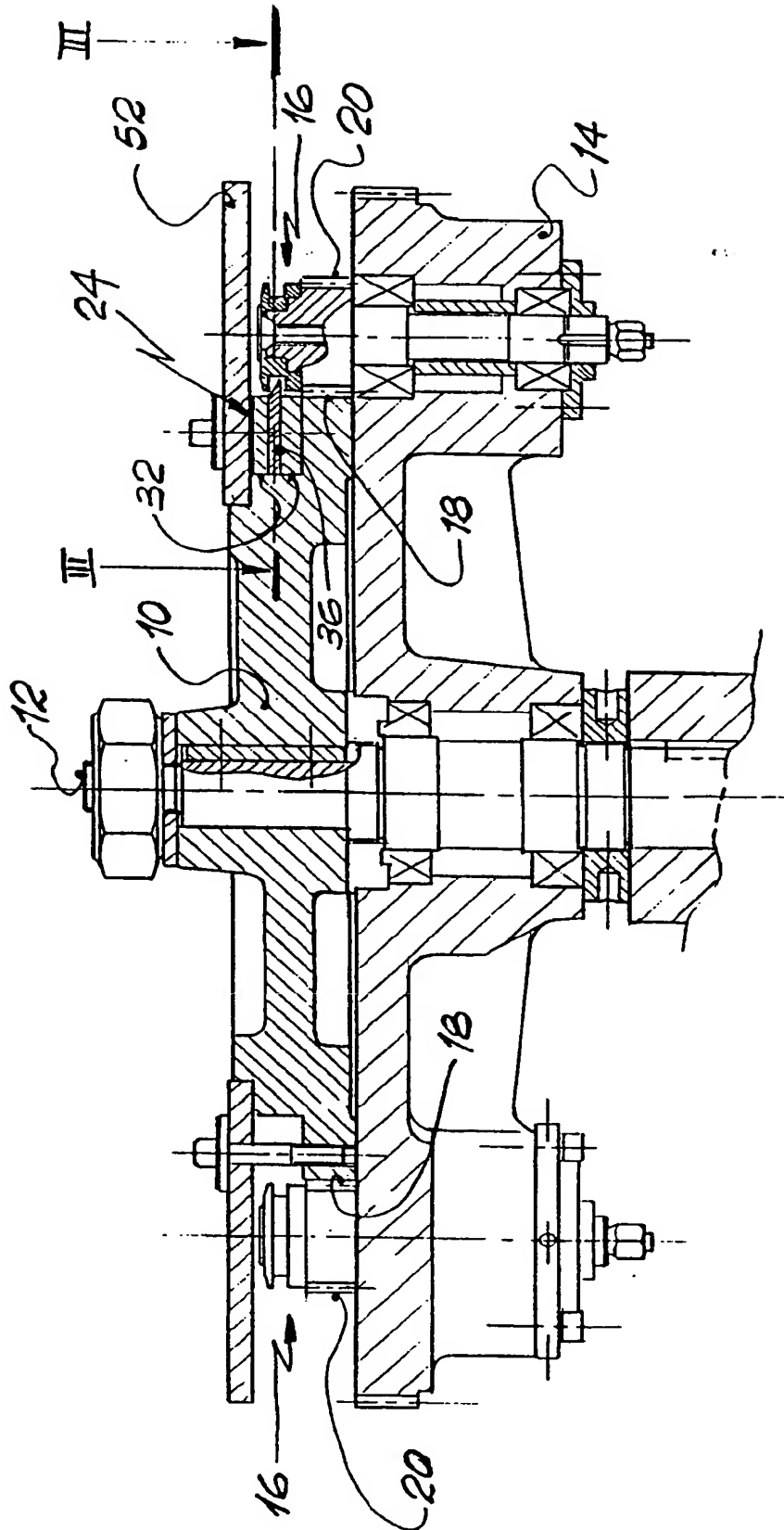


FIG. 2

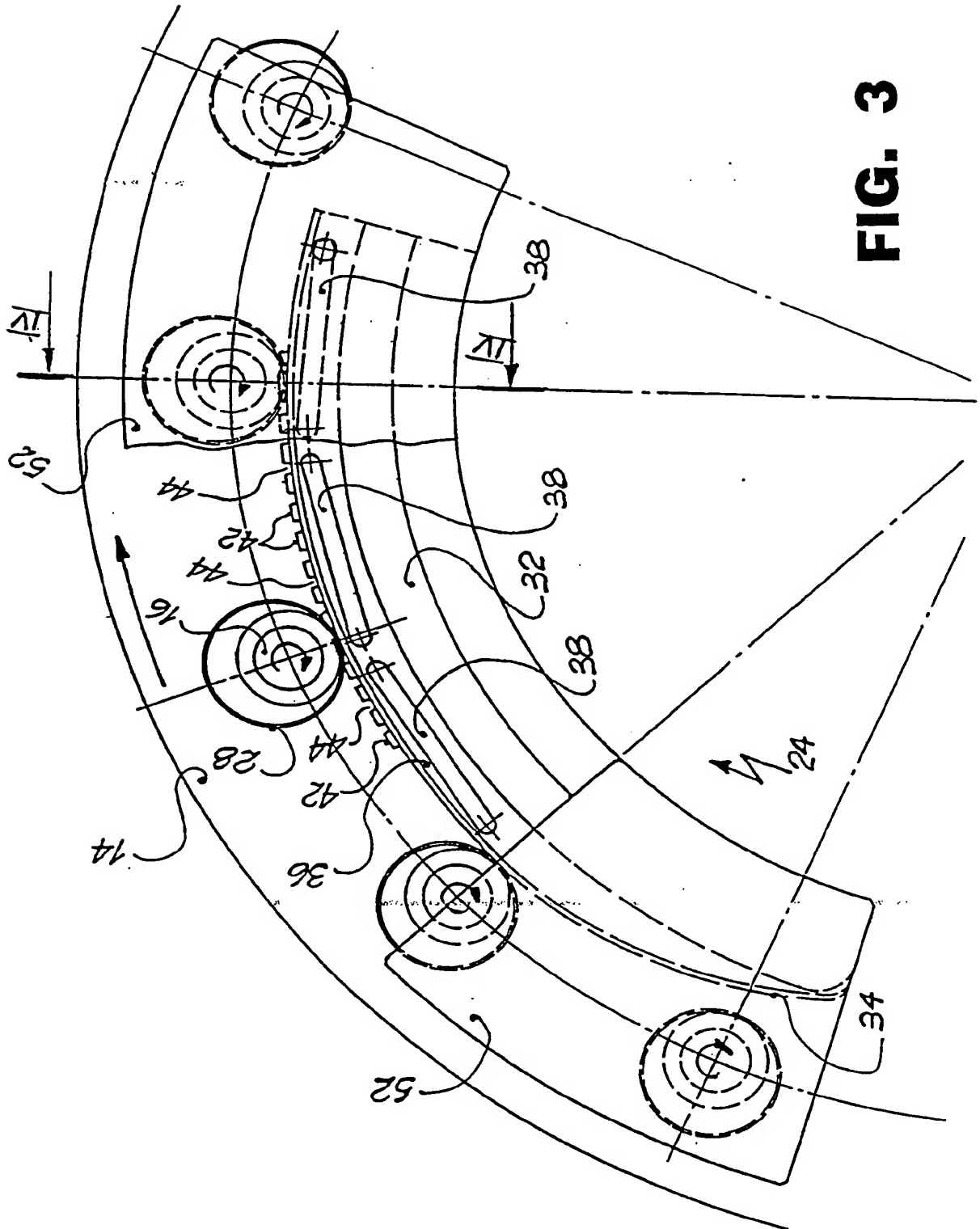


FIG. 3

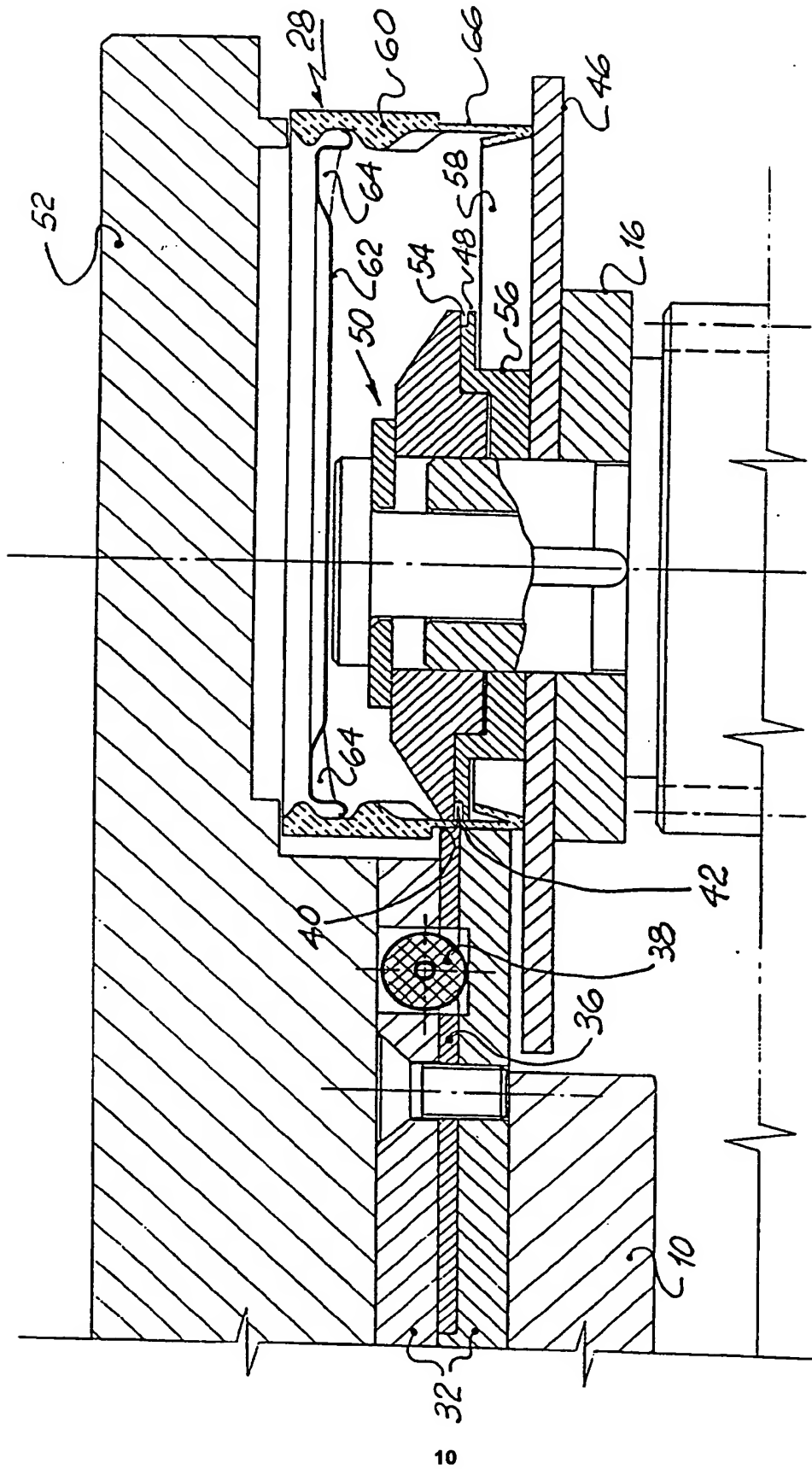


FIG. 4



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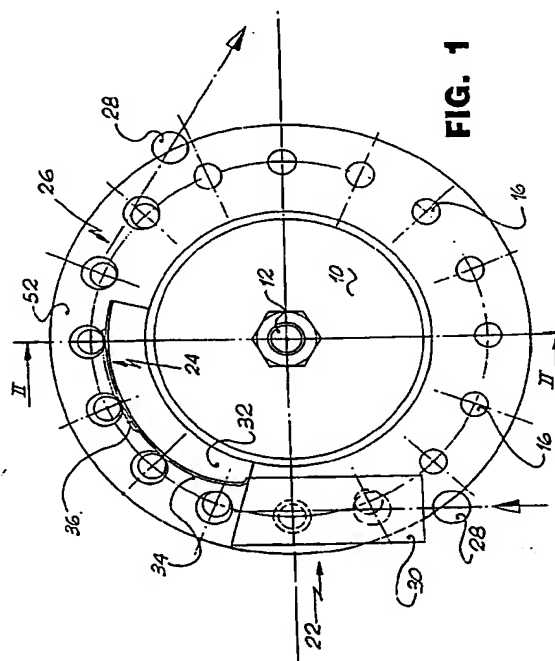
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and a device which holds said ring (66) of said cap (28) in forced contact with said support surface and at the same time brings about a reciprocal rolling movement, without slipping, of the cap (28), relative to the surface (40), in the direction of alignment of said cutting teeth (42),

the arrangement being such that the breakable bridges which remain in place on said ring (66), in positions corresponding to the gaps (44), are located along a circumference lying in a plane at right angles to the axis of the cap (28).



EP 0 533 633 A3



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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2 393 736 (LINDNER INDUSTRIE B.V) THE WHOLE DOCUMENT ----	1-8, 12, 13	B26F1/00 B65D41/34 B26F1/20 B21D51/50
X	EP-A-0 228 618 (LUCH) * page 22, line 2 - line 24; figures 7-9 * -----	1, 4, 8-12	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B26F B21D B65D B29C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17 JUNE 1993	Examiner BERGHMANS H.F.
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